

said collar piece so as to reduce thermal conduction from the slug piece to the collar piece and provide a temperature difference between the slug piece and the collar piece when the central portion of the rear face of the button member is electron heated in use.

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20. An indirectly heated cathode as claimed in Claim 19, wherein the peripheral portion of said front face provided by the collar piece is substantially co-planar with at least a circumferential part of the central portion of said front face provided by the slug piece.

21. An indirectly heated cathode as claimed in Claim 19, wherein the collar piece has a central bore accommodating the slug piece, the central bore having an inner end having a reduced diameter, the slug piece being shrink fit in said reduced diameter inner end of the bore.

22. An indirectly heated cathode as claimed in Claim 19, wherein the slug piece protrudes rearwardly relative to the collar piece so that the central portion of the rear face of the button member is rearward of the peripheral portion of said rear face.

23. An indirectly heated cathode as claimed in Claim 19, wherein the slug piece and the collar piece of the button member are made of the same material.

24. A method of creating a plasma for use in ion implantation, comprising the steps of

providing an indirectly heated button cathode having a button member with a front face and a rear face, said button member comprising a collar piece and a central slug piece secured in the collar piece, the slug piece providing respective central portions of said front and rear faces and the collar piece providing respective peripheral portions thereof,

accelerating thermionic electrons preferentially onto said central portion of said rear face to heat the slug piece relative to the collar piece to cause thermionic emission of electrons from said central portion of said front face,

reducing thermal conduction from the slug piece to the collar piece to provide a temperature difference between the slug piece and the collar piece,

and electrically biasing the cathode to accelerate said thermionically emitted electrons from said front face to ionize gas molecules to produce a plasma.

25. A method of forming a button member for an indirectly heated cathode for an ion source, the button member having a front face for emitting thermionic electrons, when in use, to form a plasma and a rear face opposite said front face for exposure to electron heating in use, the method comprising the steps of:

a) providing a collar piece and a slug piece for securing in the collar piece so that the slug piece provides respective central portions of said front and rear faces and the collar piece provides respective peripheral portions of the front and rear faces

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surrounding said central portions, the collar piece having a central bore to accommodate the slug piece wherein the central bore has an inner end having a reduced diameter, and

b) cooling the slug piece in liquid nitrogen to shrink fit the slug piece into the reduced diameter inner end of the bore in the collar piece.--

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